

Affidavit of Dr. Gregory Rose

1. My name is Dr. Gregory Rose. I am an independent consultant working with Media Access Project on matters pertaining to WT Docket Nos. 05-211, 06-150 and PS Docket No. 06-229.

INTRODUCTION

2. I have completed a study of signaling behaviors and new-entrant exclusion strategies in the FCC's AWS-1 spectrum auction. The comments below are based on that study and represent a summary of that study's findings. These findings bear directly on the rules to be drafted for the 700 MHz auction, particularly on the issue of anonymous bidding.

A. Signaling Behaviors Are a Threat to Revenue Maximization in FCC Auctions

3. Signaling represents a direct threat to revenue maximization in FCC spectrum auctions. A considerable theoretical literature exists which points to the demand reduction effects of signaling and similar tacitly collusive strategies in simultaneous, open, ascending, multi-object auctions.¹ The

¹ George Mailath, George and Peter Zmsky, "Collusion in Second Price Auctions with Heterogeneous Bidders," *Games and Economic Behavior*, 3 (1991); Richard Engelbrecht-Wiggans and Charles M. Kahn, "Low Revenue Equilibria in Simultaneous Auctions," working paper, University of Illinois, 1999; Lawrence M. Ausubel and Peter Cramton, "Demand Reduction and Inefficiency in Multi-Unit Auctions," working paper, University of Maryland, 1999; Peter Cramton and Jesse Schwartz, "Collusive Bidding: Lessons from the FCC Spectrum Auctions," *Journal of Regulatory Economics*, 17 (2000); Robert C. Marshall and Michael J. Meurer, "The Economics of Bidder Collusion," in K. Chatterjee and W.F. Samuelson, eds., *Game Theory and Business Applications* (Norwell, MA., 2001); Sandro Brusco and Giuseppe Lopomo, Giuseppe, 2002. "Collusion via Signalling in Simultaneous Ascending Bid Auctions with Heterogeneous Objects, with and without Complementarities," *Review of Economic Studies*, 69:2 (2002).

underlying intuition is that to the extent to which retaliation forces competitors out of bidding for a license the retaliating bidder obtains the license at a lower price than would otherwise obtain, reducing revenue from the auction by reducing demand from bidders threatened by retaliation. As Brusco and Lopomo note,

The presence of multiple objects facilitates collusion by allowing the bidders to signal their willingness to abstain from competing over certain objects, provided they are not challenged on others. In this way, the bidders can allocate the objects among themselves without paying much.²

The problem of signaling is simply one more case which falsifies the “Linkage Principle,”³ as it has been termed by Paul Milgrom. The “Linkage Principle” holds that auction structures which disclose more information to bidders increase auction revenue. This “principle” has been shown to be false for auctions in which multiple objects and multidimensional bidder types are present.⁴ This is particularly important because the “Linkage Principle” is the principal theoretical rationale for open bidding.

4. In 1999 Peter Cramton and Jesse A. Schwartz circulated the results of an extensive study of code bidding and retaliatory bidding, two primary methods of signaling, in the Personal Communications Services (PCS) auction for

² *Op. cit.*, 1.

³ Paul Milgrom and Robert Weber, “The Theory of Auctions and Competitive Bidding”, *Econometrica*, 50 (1982).

⁴ Motty Perry and Philip J. Reny, “On the Failure of the Linkage Principle in Multi-Unit Auctions,” *Econometrica*, 67 (1999). More recent scholarship has extended finding of failure of the “Linkage Principle” to a wider range of auction structures: Vijay Krishna, *Auction Theory* (San Diego, CA, 2002); Thierry Foucault and Stefano Lovo, “Linkage principle, Multi-dimensional Signals and Blind Auctions.” working paper, HEC School of Management, 2003; S. Board, “Revealing Information in Auctions: The Efficiency Effect,” working paper, University of Toronto, 2004.

broadband frequency blocks D, E, and F (auction 11), held from August 1996 to January 1997.⁵ While Cramton and Schwartz found relatively small direct demand reduction effects in this auction -- \$29.8 million to \$38.1 million, depending on the estimation method – they found that signaling bidders paid 36 percent less than non-signaling bidders for the D and E blocks and 18 percent less for the F block. As they concluded, “[g]iven that signaling bidders won about 40% of the available licenses, this indicates that the indirect losses associated with signaling may be quite large.”⁶

B. This Study Involves an Application of the Cramton-Schwartz Methodology to the Identify Signaling Behaviors and Related Demand Reduction Effects in the AWS-1 Auction to.

5. This study is a replication of the Cramton and Schwartz study of the PCS auction, applying the methodology which they developed to the AWS-1 auction (auction 66), held from August to September 2006. Cramton and Schwartz describe their methodology:

To find the retaliating bids and code bids in the DEF auction, we needed a consistent way to comb through the 23,157 bids, looking for those bids resembling those examples in Section 3. Our strategy was to loop through each bid, to tentatively assume the bid was a retaliating bid, and then to check whether the bid met criteria characteristic of retaliating bids. For each bid, we used the reported information to determine which bidder made the bid, which bidder it bumped when it placed the bid (i.e., the standing high bidder as of the prior round), the market and block, and the round the bid was placed. For a bid to be a retaliating bid, it must be clear to the bidder being bumped that the bid was not meant to win the license, but was only meant to punish. Therefore, we first eliminated all bids made by a bidder that had shown interest by bidding on any block of the same market in the prior 10 rounds. Of course, if a retaliating bid was made in the previous 10 rounds, and then a follow-up retaliating bid was made, our algorithm did not catch the second retaliating bid—the program was designed to catch only the first retaliating bid.

⁵ Peter Cramton and Jesse A. Schwartz, “Collusive Bidding in FCC Spectrum Auctions,” working paper, University of Maryland, 1999; the paper was later published as “Collusive Bidding in FCC Spectrum Auctions,” *Contributions to Economic Policy & Analysis*, I:1 (2004), article 11.

⁶ *Ibid.*, 28.

To be a retaliating bid, we required a clear motive: the bumped bidder must have recently been bidding for a market the retaliating bidder wanted. To ensure this, we required that the bumped bidder bumped the retaliating bidder from some license in the prior two rounds. We also required that within two rounds of placing the retaliating bid, the retaliating bidder had bid on the contested market; otherwise, it is unclear what the retaliating bid was meant to accomplish.

If a bid met the above criteria, then it certainly met many characteristics of a retaliating bid. Our next step was to examine all of the bids returned from the above algorithm to further check that they resemble code bidding or retaliating bidding. Sometimes by looking at the retaliating bid we learned that the bid was not intended as retaliation. For example, if the bidder had bid on this market intermittently throughout the auction, then the bid was probably not meant to punish. Looking at the bids manually, we then eliminated any results returned by our algorithm included if:

1. The bidder did not consistently adhere to a punishment strategy. If it punished once and it was not successful in deterring its rival, and then no follow-up retaliating bids were placed, then we did not view this as a retaliating bid.
2. The retaliating bid worked too quickly. If only one retaliating bid was placed and on a market the retaliating bidder had shown interest on earlier in the auction, if the retaliating bid did not contain a relevant market number, and if the competitor conceded, then we view this as coincidental, and not strong enough evidence to conclude that this was a retaliating bid.
3. The intentions of the bidder were unclear. If the bidder and the punished bidder were competing contemporaneously on several markets, and the punishing bid did not contain a market number, then we view these bids as being ambiguous in intent.
4. The punished bidder did not securely hold the high bid on the license being punished. If a third bidder was bidding on this market in the three rounds prior to the punishing bid, then it is not clear that the punishment had any bite.⁷

Since changes to FCC auction rules since the PCS auction have made code bidding impossible, identification of code bidding was not necessary in this study. Furthermore, while Cramton and Schwartz excluded bids before the 40th round because few licenses were obtained that early and the exclusion made their analysis more tractable, it was not possible to do so in this study,

⁷ Ibid, 8-9.

because many important licenses were obtained before the 20th round. Bids in all rounds were, therefore, subjected to scrutiny. The AWS-1 auction involved 168 qualified bidders, who placed 16,197 bids on 1,087 licenses (the FCC held an additional 35 licenses on which no bids were placed by the end of the auction). The data used was provided by the FCC.

C. Retaliatory Bidding Occurred in the AWS-1 Auction.

6. The algorithm described above identified 371 candidates for retaliatory bids from among 16,197 bids in the AWS-1 auction. Examination of these candidate bids for subjective factors in 1-4 in the Cramton-Schwartz methodology identified 31 of these as retaliatory bids. These bids were then designated as successful or unsuccessful, depending on whether the bidder retaliated against withdrew from further competition from the license which occasioned the retaliation. Table 1 presents this distribution:

**Table 1.
Retaliatory Bids in the AWS-1 Auction**

	BEA ⁸	CMA ⁹	Total
Successful	7	6	13
Unsuccessful	5	13	18
Total	12	19	31

⁸ There were 176 20 MHz licenses in the Basic Economic Area B Block (BEA) and 176 10 MHz licenses in the 10 MHz Basic Economic Area (BEA) C Block.

⁹ There were 734 20 MHz licenses in the Cellular Market Area A Block.

Retaliatory bids constituted, thus, 0.19 percent of all bids placed in the AWS-1 auction. In the PCS auction Cramton and Schwartz identified 37 instances of retaliatory bidding, or 0.16 percent of all bids placed in the PCS auction. However, 23 of these bids constituted code bidding, which was not available to bidders in the AWS-1 auction, leaving 14 cases of retaliatory of the sort identified in the AWS-1 auction, or 0.06 percent of the PCS bids. It is clear that retaliatory bidding has increased in the AWS-1 auction over the rate found by Cramton and Schwartz in the PCS auction. The rate of successful retaliation has decreased slightly in the AWS-1 auction, 41.94% versus 51.35%. Retaliatory bids in the AWS-1 auction were significantly more likely to be successful for the BEA licenses than the CMA licenses; this is almost certainly an artifact of the higher rates of competition seen for the CMA licenses

D. Demand Reduction Effects From Retaliatory Bidding Were Observed in the AWS-1 Auction.

7. The indirect demand reduction effects of signaling arise from awareness on the part of bidders -- and not just the bidder retaliated against -- that others bidders are willing to engage in retaliatory bidding. This awareness creates risk aversion on the part of potentially threatened bidders who respond by avoiding challenging those bidders suspected of retaliatory bidding lest they become victims of retaliation themselves. In these circumstances it becomes irrelevant whether a retaliatory bidder's retaliations are successful a majority of the time, since there is no way to

predict how effective a future retaliation will be. As a result, bidders who engage in retaliatory bidding are likely to acquire spectrum at lower prices than those who do not employ retaliatory bidding. In this study demand reduction was indirectly measured by comparison of the mean price (measured as dollars/Mhz/population) paid for spectrum by bidders which used retaliatory bidding to that paid by bidders who did not. The mean price for spectrum paid by bidders who used retaliatory \$0.092 per MHz/pop. The mean price for spectrum paid by bidders who did not use retaliatory bidding was \$0.156 per MHz/pop. A two-tailed t-test of the difference between the means was significant at $p = 0.0125$.¹⁰ Retaliatory bidding significantly reduced prices for licenses for those bidders who engaged in it. This confirms the Cramton-Schwartz finding that indirect demand reduction effects are present when signaling occurs.

8. There is no strategy for eliminating signaling behaviors like retaliatory bidding and their demand reduction effects in ascending, multi-object auctions short of an anonymous bidding rule. The findings of this study completely confirm my contentions in opposition to relaxing of the originally proposed anonymous bidding rules for the AWS-1 auction.¹¹

¹⁰ A two-tailed t-test assesses whether the means of two groups are statistically different from each other. A p value of 0.0125 indicates that 1.25 times out of a hundred you would find a statistically significant difference between the means by random chance even if there was none, i.e., a 98.75 percent chance that the significant difference is genuine.

¹¹ “Written Ex Parte Statement of Dr. Gregory Rose on Behalf of NHMC, *et al.* in Opposition to the Proposed ‘Compromise’ on Anonymous Bidding,” WT Docket No. 05-211/ AU Docket No. 06-33, April 5, 2006.

E. A Broader Definition of Market Structure is Necessary for Analysis of the AWS-1 Auction.

9. Before discussing strategies for exclusion of new entrants it is important to be clear about the market structure underlying the AWS-1 auction. The tendency to narrowly define this market as only wireless broadband provision obscures more than it illuminates, and it runs contrary to current theorizing in industrial organization. The wireless broadband market is nested in a more general broadband provision market and not merely firms which have substantial pre-existing wireless broadband deployments; thus firms with substantial pre-existing DSL and cable modem broadband deployments must be regarded as critically-positioned incumbents for the AWS-1 auction. It is precisely the extraordinary capitalization resources of these latter firms, mainly cable and telephone companies, and their ability to integrate wireless broadband delivery with their existing systems which had enormous effect on their ability to succeed in the AWS-1 auction. This study, therefore, treats such bidders as incumbents.

F. Major Incumbents Pursued a Strategy of Excluding Potentially Threatening New Entrants from Acquiring National Footprint in the AWS-1 Auction.

10. The study also focused on strategies adopted by incumbents for exclusion of new entrant from acquisition of spectrum in the AWS-1 auction. The absence of anonymous bidding in the AWS-1 auction also afforded opportunities for incumbents to identify new entrants who represented a serious competitive

threat and block them by concentrating on rapidly outbidding them on licenses necessary for acquisition of a national AWS footprint. These tactics, for example, placed the principal DBS bidder, Wireless DBS LLC, in the AWS-1 auction at a considerable disadvantage. Wireless DBS LLC was unable to acquire a national footprint at auction, particularly in the Cellular Market Area (CMA) and Regional Economic Area Grouping (REAG) licenses, in large part because incumbent telephone and cable broadband providers were able to identify and block Wireless DBS LLC bids. Other new entrants such as Atlantic Wireless LP, Antares Holdings LLC, and Dolan Family Holdings LLC were also blocked. Atlantic Wireless obtained only 12.20% of the licenses upon which it bid; Antares Holdings and Dolan Family Holdings, like Wireless DBS, obtained no licenses. Wireless DBS LLC was sufficiently blocked that it effectively withdrew from the auction after the eleventh round. Dolan Family Holdings LLC withdrew after the twentieth round. Antares Holdings LLC withdrew after the thirtieth round. Atlantic Wireless LP was able to persevere through round ninety-seven.

Notable among incumbents participating in such blocking behavior were T-Mobile License LLC, SpectrumCo LLC, and Cingular AWS LLC. Barat Wireless LP,¹² MetroPCS AWS LLC, Denali Spectrum License LLC, and Cricket Licensee (Reauction),¹³ Inc. also engaged in this blocking behavior. These incumbents obtained significant percentages of the licenses

¹² Barat Wireless LP is primarily owned by U.S. Cellular Corporation.

¹³ Denali Spectrum License LLC and Cricket Licensee (Reauction) are primarily owned by LEAP International Wireless, Inc.

on which they bid: T-Mobile obtained 41.52% of the licenses on which it bid, SpectrumCo 60.89%, Cingular AWS 22.07%, Barat Wireless 25.76%, and Cricket Licensee (Reauction) 37.64%,. MetroPCS AWS and Denali Spectrum acquired significantly less of the licenses on which they bid – 12.12% and 5.88%, respectively. These two incumbents faced significant challenge from other incumbents as a result of intersecting bidding strategies. Although a major incumbent, Verizon chose less frequently to engage in blocking new entrant acquisition of national footprint; it still obtained 61.90% of the licenses on which it bid.

For purposes of this study, an incumbent was defined as a bidder owned by firm(s) with significant, pre-existing broadband deployment, whether wireless or landline. A targeted new entrant was defined as an entrant which bid on ten or more licenses and which was challenged by two or more incumbents at a rate at least two standard deviations higher than the mean rate at which each incumbent challenged all bidders. A challenged incumbent was defined as an incumbent which was challenged by two or more incumbents at a rate at least two standard deviations higher than the mean rate at which each incumbent challenged all bidders. Table 2 shows the rate of challenge on licenses by incumbents in standard deviations from the mean number of challenges to all bidders by each incumbent:

Table 2.
Rate of Challenge by Incumbents in Standard Deviations from the Mean of Each Incumbent

Challenging Incumbents

Challenged Bidders	T-Mobile License LLC	SpectrumCo LLC	Cingular AWS LLC	Cricket Licensee (Reauction), Inc.	Barat Wireless L.P.	Cellco Partnership d/b/a Verizon Wireless	Denali Spectrum License LLC	MetroPCS AWS LLC
18th Street Spectrum, LLC	0.5769	0.1334	-0.1065	0.0313	1.4360	-0.2013	-0.1858	-0.2559
3 Rivers Telephone Cooperative Inc	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
ACS Wireless License Sub, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Advanced Communications Technology, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Agri-Valley Communications	0.2794	-0.4724	-0.0820	-0.5292	-0.3930	-0.2013	-0.1858	0.3565
Alenco Communications, Inc.	0.2794	-0.4724	-0.4508	0.6719	-0.3930	-0.2013	-0.1858	-0.2559
Allcom Communications, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
American Cellular Corporation	0.4686	0.2937	0.3298	0.3751	0.5640	-0.2013	-0.0554	-0.1063
Antares Holdings LLC	1.7670	2.7728	3.0532	2.0231	0.0969	-0.2013	0.6156	3.1122
Arapahoe Telephone Company d/b/a ATC Communication	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
AST Telecom, LLC	-0.4644	4.0708	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Atlantic Seawinds Communications, LLC	4.7421	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Atlantic Wireless LP	2.1600	2.6672	2.7818	2.0341	1.6144	0.5377	0.2703	-0.2559
AWS Wireless Inc.	1.1594	0.8897	0.8999	0.9172	0.4074	0.1035	0.0173	0.4859
Aztech Communications, Inc.	-0.4644	-0.4724	-0.4508	3.6746	-0.3930	-0.2013	-0.1858	-0.2559
Barat Wireless LP	1.5078	1.5927	2.1311	-0.5292	-	0.7169	0.4941	0.3936
Beehive Telephone Company, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
BEK Communications Cooperative	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Bend Cable Communications, LLC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Big Bend Telecom, LTD	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Big River Telephone Company, LLC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Blackfoot Telephone Cooperative Inc	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Blue Valley Tele-Communications, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Bluestreak Wireless LLC	0.1141	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
BPS Telephone Company	4.7421	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Breda Telephone Corp.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
C&W Enterprises Inc.	-0.4644	-0.4724	-0.4508	-0.3136	-0.3930	-0.2013	-0.1858	-0.2559
Cable One Inc	-0.4644	-0.4724	-0.4508	-0.5292	-0.0413	-0.2013	-0.1858	-0.2559
Cal-Ore Telephone Co.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Carolina Personal Communications, Inc.	4.7421	0.6634	0.8402	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Carolina West Wireless Inc	0.8372	-0.1928	0.6084	0.1014	0.9787	-0.2013	-0.1858	0.3157
Cavalier Wireless LLC	0.7905	1.4747	-0.4508	0.5918	-0.0413	1.0418	-0.1858	-0.2559
CCTN Biddng Consortium	-0.4644	1.9074	1.7623	-0.5292	-0.3930	-0.2013	1.4170	0.5606
Cellco Partnership d/b/a Verizon Wireless	1.0232	1.9074	0.5174	1.0723	0.9134	-	-0.1858	-0.2559
Cellular South Licenses, Inc.	0.8792	0.3795	1.0680	1.7041	0.0357	-0.2013	-0.1858	0.2484
Centennial Michiana License Company LLC	0.7607	0.0621	-0.4508	-0.2819	-0.3930	-0.2013	-0.1858	1.3516
Central Texas Telephone Investments, LP	-0.4644	-0.4724	-0.4508	-0.2664	-0.3930	-0.2013	-0.1858	-0.2559
Central Utah Telephone Company	-0.4644	-0.4724	0.0583	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559

CenturyTel Broadband Wireless LLC	0.2689	0.5515	3.2376	0.6550	0.9594	1.9324	-0.1858	-0.2559
Chariton Valley Communication Corporation, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Chequamegon Communications Cooperative Inc	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Chester Telephone Company	-0.4644	-0.4724	-0.4508	3.6746	-0.3930	-0.2013	-0.1858	-0.2559
Churchill County Telephone d/b/a CC Communications	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Cincinnati Bell Wireless LLC	0.5369	1.4498	0.5422	0.7643	-0.3930	-0.2013	-0.1858	1.8362
Cingular AWS LLC	1.8524	2.3318	-	1.8845	1.7729	1.1035	0.6731	-0.2559
City of Ketchikan dba Ketchikan Public Utilities	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Clay County Rural Telephone Cooperative, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Clinker LLC	-0.4644	-0.4724	-0.4508	3.6746	-0.3930	-0.2013	-0.1858	-0.2559
Coleman County Telecommunications, LTD	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Command Connect LLC	-0.4644	1.1178	-0.4508	0.9422	-0.3930	8.8884	-0.1858	0.1728
Comporium Wireless, LLC	2.1389	-0.4724	-0.4508	1.5727	-0.3930	-0.2013	-0.1858	-0.2559
Craw-Kan Telephone Cooperative Inc	-0.4644	-0.4724	1.9053	0.3116	-0.3930	-0.2013	-0.1858	-0.2559
Cricket Licensee (Reauction) Inc	1.4955	1.6524	-0.4508	-	1.4325	0.7204	0.4114	0.9502
Cross Telephone Company	-0.4644	-0.4724	-0.4508	0.3116	2.3505	-0.2013	-0.1858	-0.2559
CTC Telcom, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Dakota Wireless Group LLC	-0.4644	-0.4724	0.3571	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Daredevil Communications LLC	0.4565	0.9184	4.4093	0.5575	0.1669	0.0048	-0.1095	0.3857
Denali Spectrum License LLC	1.0669	3.5363	-0.4508	2.9328	2.8346	5.1456	-	5.2915
Diller Telephone Company	-0.4644	-0.4724	-0.4508	-0.5292	6.4657	-0.2013	-0.1858	-0.2559
Dolan Family Holdings LLC	1.9386	1.6245	3.1242	1.0877	-0.3930	2.1294	4.1295	3.7010
Ellijay Telephone Company	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
ETCOM, LLC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Farmers Mutual Telephone Company	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Farmers Telecommunications Cooperative, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Fidelity Communications Company	-0.4644	-0.4724	-0.4508	-0.1470	-0.3930	-0.2013	-0.1858	-0.2559
FMTC Wireless, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
FTC Management Group, Inc.	-0.4644	1.7992	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Graceba Total Communications Inc	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Grand River Communications, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Granite State Long Distance, Inc.	2.1389	-0.4724	2.1311	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Green Hills Area Cellular Telephone, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Hancock Rural Telephone Corporation	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Hawaiian Telcom Communications, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Heart of Iowa Communications Cooperative	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Hemingford Cooperative Telephone Company	-0.4644	-0.4724	-0.4508	1.5727	0.5215	-0.2013	-0.1858	-0.2559

Hill Country Telephone Cooperative Inc	-0.4644	1.7992	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Horry Telephone Cooperative, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Innovative Communication Corporation	-0.4644	4.0708	-0.4508	-0.1088	-0.3930	-0.2013	-0.1858	-0.2559
Iowa Integra Consortium LLC	0.5769	-0.4724	0.5820	-0.5292	3.0364	-0.2013	-0.1858	-0.2559
Iowa Telecommunications Services Inc	-0.2474	0.6634	-0.0205	-0.5292	1.3217	-0.2013	-0.1858	-0.2559
James Valley Jefferson Telephone Company	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Kingdom Telephone Company	-0.4644	-0.4724	-0.4508	0.8721	-0.3930	-0.2013	-0.1858	-0.2559
KTC AWS Limited Partnership	-0.4644	-0.4724	-0.0536	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
La Ward Cellular Telephone Company, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
LCDW Wireless Limited Partnership	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Leaco Rural Telephone Cooperative Inc	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Ligtel Communications, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
LL License Holdings II, LLC	0.0395	0.1139	0.8818	-0.2580	2.7045	-0.2013	-0.1858	-0.2559
Lynch AWS Corporation	1.4881	0.6634	0.1947	-0.0037	1.3217	-0.2013	-0.1858	0.8158
MAC Wireless, LLC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Manti Telephone Company	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
McDonald County Telephone Company	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Mediapolis Telephone Company	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
MetroPCS AWS, LLC	2.3755	3.1760	3.5394	1.8275	0.6462	0.7169	1.6841	-
Midwest AWS Limited Partnership	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Mt. Vernon. Net, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
MTA Communications, Inc.	0.2794	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	1.4170	-0.2559
MTPCS License Co., LLC	-0.4644	-0.1316	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Muenster Telephone Corp. of Texas	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Mutual Telephone Company	-0.4644	1.0420	-0.4508	-0.5292	4.1795	-0.2013	-0.1858	-0.2559
NEIT Wireless, LLC	-0.4644	-0.4724	0.2869	-0.5292	3.5263	-0.2013	-0.1858	-0.2559
North Dakota Network Company	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Northeast Missouri Rural Telephone Company	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Northeast Nebraska Telephone Company	-0.4644	-0.4724	-0.4508	-0.5292	3.0364	-0.2013	-0.1858	-0.2559
Northern Iowa Communications Partners, LLC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Northwest Missouri Cellular Limited Partnership	2.1389	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
NSIGHTTEL Wireless, LLC	0.5273	-0.4724	0.7787	-0.5292	1.5666	-0.2013	-0.1858	-0.2559
NTELOS Inc.	0.4034	2.5564	2.9918	0.8721	-0.3930	-0.2013	-0.1858	-0.2559
Palmetto Rural Telephone Cooperative, Inc.	1.2711	1.0420	2.9918	2.2734	-0.3930	-0.2013	-0.1858	-0.2559
Panhandle Telecommunication Systems, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Panora Telecommunications, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Partnership Wireless LLC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559

Paul Bunyan Rural Telephone Cooperative	-0.4644	-0.4724	0.1947	-0.0037	-0.3930	-0.2013	-0.1858	-0.2559
PCS Partners, L.P.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Perry-Spencer Rural Telephone Coop., Inc. dba PSC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
PetroCom License Corporation	-0.4644	-0.4724	-0.4508	1.5727	-0.3930	-0.2013	-0.1858	-0.2559
Pine Cellular Phones, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Plains Cooperative Telephone Association, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Plateau Telecommunications, Inc.	0.1141	-0.2200	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	0.2204
Public Service Wireless Services, Inc.	-0.1751	1.2944	-0.1639	0.1715	-0.3930	-0.2013	-0.1858	-0.2559
Rainbow Telecommunications Association, Inc.	-0.4644	-0.4724	-0.4508	3.6746	-0.3930	-0.2013	-0.1858	-0.2559
Red Rock Spectrum Holdings, LLC	-0.4644	-0.1633	-0.3103	-0.3290	0.0736	-0.2013	-0.1858	-0.1976
Reservation Telephone Cooperative, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Roberts County Telephone Cooperative Association	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Rodriguez, Marcos	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Ropir Communications, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Route 66 Wireless, LLC	-0.4644	-0.4724	-0.4508	0.0714	-0.3930	-0.2013	-0.1858	-0.2559
Salina Spavinaw Telephone Co.Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Sandhill Communications, LLC	-0.4644	-0.4724	-0.4508	3.6746	-0.3930	-0.2013	-0.1858	-0.2559
Shenandoah Mobile Company	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Shoreline Investments LLC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
SKT, Inc.	-0.4644	-0.4724	0.5820	0.3116	2.3505	-0.2013	-0.1858	-0.2559
Smithville Spectrum, LLC	-0.4644	-0.4724	-0.4508	0.8721	-0.3930	-0.2013	-0.1858	-0.2559
South #5 RSA Limited Partnership d/b/a Brazos Cell	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
South Slope Cooperative Telephone Company, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Southeastern Indiana Rural Telephone Coop., Inc.	-0.4644	-0.4724	-0.4508	1.5727	-0.3930	-0.2013	-0.1858	-0.2559
Space Data Spectrum Holdings, LLC	0.0090	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	0.8341	-0.2559
SpectrumCo LLC	0.8219	-	2.1615	1.4985	1.2208	-0.2013	0.4741	1.5260
Spotlight Media Corp	0.2794	0.8257	0.5328	-0.1288	0.2602	-0.2013	-0.1858	-0.2559
St. Cloud Wireless Holdings, LLC	3.4405	-0.4724	-0.4508	0.5218	-0.3930	-0.2013	-0.1858	-0.2559
Stayton Cooperative Telephone Company	-0.4644	-0.4724	-0.4508	0.5218	-0.3930	-0.2013	-0.1858	-0.2559
Telephone Electronics Coporation	-0.4644	-0.4724	0.1947	0.5218	-0.3930	-0.2013	-0.1858	-0.2559
The Chillicothe Telephone Company	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
The Pioneer Telephone Association, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
The S&T Telephone Cooperative Association, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
The Tri-County Telephone Association, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Three River Telco	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
T-Mobile License LLC	-	0.8324	1.5861	1.2309	1.2208	0.6375	0.3189	1.2274
Triad AWS, Inc.	0.8372	1.6960	1.6617	1.0950	1.1658	0.4873	0.5791	1.3029

Tri-Valley Communications, LLC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Union Telephone Company	-0.4644	-0.2748	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
United Telephone Mutual Aid Corp.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
United Wireless Communications Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Van Buren Wireless, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Vermont Telephone Company, Inc.	0.0090	0.5372	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Volcano Internet Provider	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
West Carolina Piedmont Bidding Consortium	-0.4644	-0.4724	-0.4508	2.2734	-0.3930	-0.2013	-0.1858	-0.2559
West Central Communications LLC	-0.4644	-0.4724	0.5820	0.3116	-0.3930	-0.2013	-0.1858	-0.2559
West Central Telephone Association	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Western New Mexico Telephone Company, Inc.	-0.4644	1.7992	2.1311	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Wheat State Telephone, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Wireless DBS LLC	2.7897	3.6449	3.9062	2.2296	2.1790	6.4266	3.6710	4.8345
Wittenberg Telephone Company	0.4823	-0.4724	1.0984	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
WUE INC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
WWW Broadband, LLC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
XIT Leasing, Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
XIT Telecommunication & Technology, Ltd.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559

Bold face: Two or more standard deviations from incumbent mean

Targeted New Entrant
Challenged Incumbent

Note that Wireless DBS LLC was challenged by all eight incumbents at a rate higher than two standard deviations from the mean of each incumbent; Atlantic Wireless LP, Antares Holdings LLC, and Dolan Family Holdings LLC were each challenged by four incumbents at a rate higher than two standard deviations from the mean of each incumbent. NTELOS Inc. was challenged by two incumbents at a rate higher than two standard deviations from the mean of each incumbent. No other new entrants were challenged at

this rate by this array of incumbents.¹⁴ As Table 3 indicates, a two-tailed t-test revealed that the difference between the rate at which incumbents challenged targeted new entrants and the rate at which they challenged all other bidders was statistically significant for all incumbents except Barat Wireless LP:

Table 3.
Results of Two-Tailed t-Test of Difference Between
the Mean Rates of Challenge by Incumbents
Against Targeted New Entrants and Against All
Other Bidders¹⁵

	DF	T	P-value
T-Mobile License LLC	165	-4.3272	<0.0001
SpectrumCo LLC	165	-6.7935	<0.0001
Cingular AWS LLC	165	-8.6563	<0.0001
Cellco Partnership d/b/a Verizon Wireless	165	-4.1331	<0.0001
Denali Spectrum License LLC	165	-9.6572	<0.0001
MetroPCS AWS LLC	165	-7.8983	<0.0001
Cricket Licensee (Reauction), Inc.	165	-3.9016	0.0001
Barat Wireless LP	165	-1.4137	0.1593

No similar pattern of concentrated challenges by targeted new entrants was observed in the AWS-1. Table 4 shows the rate of challenge on licenses by targeted new entrants in standard deviations from the mean number of challenges to all bidders by each targeted new entrant:

¹⁴ Two incumbents, Denali Spectrum Holdings LLC and MetroPCS AWS LLC, were challenged by other incumbents at relatively high rates. This appears to have been a consequence of similarities in underlying bidding profile and an epiphenomenon of the smaller package of licenses each bid on in attempting to block the targeted new entrants.

¹⁵ See footnote 10 above.

Table 4.
Rate of Challenge by Targeted New Entrants in Standard Deviations from the
Mean of Each Targeted New Entrant

Challenged Bidders	<u>Challenging New Entrants</u>				
	Antares Holdings LLC	Atlantic Wireless LP	Dolan Family Holdings LLC	NTELOS Inc.	Wireless DBS LLC
18th Street Spectrum, LLC	-0.1598	0.5881	-0.1396	0.6149	-0.2210
3 Rivers Telephone Cooperative Inc	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
ACS Wireless License Sub, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Advanced Communications Technology, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Agri-Valley Communications	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Alenco Communications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Allcom Communications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
American Cellular Corporation	0.2746	0.5114	0.0019	0.2615	-0.0029
Antares Holdings LLC	-	3.8223	1.1643	-0.1263	0.1140
Arapahoe Telephone Company d/b/a					
ATC Communication	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
AST Telecom, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Atlantic Seawinds Communications, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Atlantic Wireless LP	1.3154	-	0.1572	0.1449	0.0840
AWS Wireless Inc.	0.3127	0.9278	0.0318	0.0527	0.0621
Aztech Communications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Barat Wireless LP	0.0019	1.5396	-0.1396	-0.1263	0.6317
Beehive Telephone Company, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
BEK Communications Cooperative	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Bend Cable Communications, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Big Bend Telecom, LTD	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Big River Telephone Company, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Blackfoot Telephone Cooperative Inc	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Blue Valley Tele-Communications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Bluestreak Wireless LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
BPS Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Breda Telephone Corp.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
C&W Enterprises Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Cable One Inc	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Cal-Ore Telephone Co.	-0.1598	6.5040	-0.1396	-0.1263	-0.2210
Carolina Personal Communications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Carolina West Wireless Inc	-0.1598	-0.3220	-0.1396	0.4296	-0.2210
Cavalier Wireless LLC	-0.0503	0.5881	-0.1396	-0.1263	-0.0286
CCTN Biddng Consortium	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Cellco Partnership d/b/a Verizon Wireless	-0.1598	0.6531	0.4399	-0.1263	2.9056
Cellular South Licenses, Inc.	-0.1598	0.1046	-0.1396	-0.1263	-0.2210
Centennial Michiana License Company LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Central Texas Telephone	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210

Investments, LP					
Central Utah Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
CenturyTel Broadband Wireless LLC	-0.1598	0.0625	-0.1396	-0.1263	-0.2210
Chariton Valley Communication Corporation, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Chequamegon Communications Cooperative Inc	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Chester Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Churchill County Telephone d/b/a CC Communications	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Cincinnati Bell Wireless LLC	-0.1598	1.7783	-0.1396	-0.1263	-0.2210
Cingular AWS LLC	0.8105	2.1928	0.3845	0.1929	0.9908
City of Ketchikan dba Ketchikan Public Utilities	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Clay County Rural Telephone Cooperative, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Clinker LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Coleman County Telecommunications, LTD	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Command Connect LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Comporium Wireless, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Craw-Kan Telephone Cooperative Inc	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Cricket Licensee (Reauction) Inc	0.5301	1.6245	0.0918	0.0428	0.5280
Cross Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
CTC Telcom, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Dakota Wireless Group LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Daredevil Commuications LLC	0.3484	0.5138	-0.1396	-0.0507	-0.2210
Denali Spectrum License LLC	1.0959	1.6856	3.4399	-0.1263	5.8483
Diller Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Dolan Family Holdings LLC	2.3033	1.2532	-	-0.1263	4.1082
Ellijay Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
ETCOM, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Farmers Mutual Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Farmers Telecommunications Cooperative, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Fidelity Communications Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
FMTC Wireless, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
FTC Management Group, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Graceba Total Communications Inc	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Grand River Communications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Granite State Long Distance, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Green Hills Area Cellular Telephone, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Hancock Rural Telephone Corporation	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Hawaiian Telcom Communications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Heart of Iowa Communications Cooperative	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Hemingford Cooperative Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Hill Country Telephone Cooperative Inc	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210

Horry Telephone Cooperative, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Innovative Communication Corporation	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Iowa INTEGRA Consortium LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Iowa Telecommunications Services Inc	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
James Valley	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Jefferson Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Kingdom Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
KTC AWS Limited Partnership	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
La Ward Cellular Telephone Company, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
LCDW Wireless Limited Partnership	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Leaco Rural Telephone Cooperative Inc	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Ligtel Communications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
LL License Holdings II, LLC	-0.1598	-0.1019	-0.1396	-0.1263	-0.2210
Lynch AWS Corporation	-0.1598	1.3845	-0.1396	-0.1263	-0.2210
MAC Wireless, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Manti Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
McDonald County Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Mediapolis Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
MetroPCS AWS, LLC	1.6191	1.8499	0.9668	-0.1263	2.4793
Midwest AWS Limited Partnership	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Mt. Vernon. Net, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
MTA Communications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	1.1190
MTPCS License Co., LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Muenster Telephone Corp. of Texas	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Mutual Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
NEIT Wireless, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
North Dakota Network Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Northeast Missouri Rural Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Northeast Nebraska Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Northern Iowa Communications Partners, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Northwest Missouri Cellular Limited Partnership	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
NSIGHTTEL Wireless, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
NTELOS Inc.	-0.1598	4.2286	-0.1396	-	-0.2210
Palmetto Rural Telephone Cooperative, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Panhandle Telecommunication Systems, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Panora Telecommunications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Partnership Wireless LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Paul Bunyan Rural Telephone Cooperative	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
PCS Partners, L.P.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Perry-Spencer Rural Telephone Coop., Inc. dba PSC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210

PetroCom License Corporation	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Pine Cellular Phones, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Plains Cooperative Telephone Association, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Plateau Telecommunications, Inc.	-0.1598	0.0572	-0.1396	-0.1263	-0.2210
Public Service Wireless Services, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Rainbow Telecommunications Association, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Red Rock Spectrum Holdings, LLC	-0.1598	-0.2756	-0.1396	-0.1263	-0.2210
Reservation Telephone Cooperative, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Roberts County Telephone Cooperative Association	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Rodriguez, Marcos	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Ropir Communications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Route 66 Wireless, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Salina Spavinaw Telephone Co.Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Sandhill Communications LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Shenandoah Mobile Company	-0.1598	-0.3220	-0.1396	6.5449	-0.2210
Shoreline Investments LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
SKT, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Smithville Spectrum, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
South #5 RSA Limited Partnership d/b/a Brazos Cell	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
South Slope Cooperative Telephone Company, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Southeastern Indiana Rural Telephone Coop. Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Space Data Spectrum Holdings, LLC	-0.1598	-0.3220	-0.1396	-0.1263	2.3371
SpectrumCo LLC	0.6773	1.9533	0.1467	-0.0391	0.8457
Spotlight Media Corp	0.3484	0.6531	-0.1396	0.4031	0.6723
St. Cloud Wireless Holdings, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Stayton Cooperative Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Telephone Electronics Corporation	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
The Chillicothe Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
The Pioneer Telephone Association, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
The S&T Telephone Cooperative Association Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
The Tri-County Telephone Association Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Three River Telco	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
T-Mobile License LLC	0.4311	1.1896	0.3657	-0.0109	0.6553
Triad AWS, Inc.	1.0531	2.0050	0.1370	-0.1263	0.4185
Tri-Valley Communications, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Union Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
United Telephone Mutual Aid Corp.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
United Wireless Communications Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Van Buren Wireless, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Vermont Telephone Company, Inc.	2.2120	0.4364	-0.1396	-0.1263	-0.2210
Volcano Internet Provider	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210

West Carolina Piedmont Bidding Consortium	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
West Central Communications LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
West Central Telephone Association	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Western New Mexico Telephone Company, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Wheat State Telephone, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Wireless DBS LLC	0.1737	0.5312	2.1423	-0.1263	-
Wittenberg Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
WUE INC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
WWW Broadband LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
XIT Leasing Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
XIT Telecommunication & Technology Ltd.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210

Boldface: Two or more standard deviations from the mean.

Challenged New Entrant
Challenged Incumbent

One targeted new entrant, Dolan Family Holdings LLC, was challenged by two other targeted new entrants – Antares Holdings LLC and Wireless DBS LLC – at a rate higher than two standard deviations from the mean of those new entrants. Atlantic Wireless LP also came into conflict with two other targeted new entrants – Antares Holdings LLC and NTELOS Inc. Only one incumbent, Denali Spectrum License LLC, was challenged by two targeted new entrants – Antares Holdings LLC and Wireless DBS LLC -- at a rate higher than two standard deviations from the mean of those new entrants. None of these cases were statistically significant. The lack of parity to the incumbents in concentrated challenges by targeted new entrants militates against the incumbent challenges being solely the consequences of similar underlying bidding strategy of the bidders involved.

It may certainly be argued that the challenges of the incumbents to the targeted new entrants is simply an epiphenomenon of the fact that the spectrum at issue was highly sought by all bidders. This is not, in fact, true, since the bidding on the relevant spectrum involved in the main only incumbents and targeted new entrants. Furthermore, this argument seems to miss the point: most highly-prized licenses in the AWS-1 auction were highly-prized precisely because they offered complementarities to any bidder seeking national footprint or seeking to block others from attaining that footprint. In order to determine exactly what underlies the pattern of concentrated challenges by incumbents it is necessary to examine the bidding profiles of the targeted new entrants in some detail.

Antares Holdings LLC aimed at creating a base in the eastern half of the U.S. and Texas with a combination of six BEA B Block and fifteen C Block licenses, six CMA A Block licenses, and one REAG D Block license, covering nineteen states, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands with a coverage population of 130,058,101. Antares Holdings LLC is owned by a major investor in Northcoast Communications LLC, which held a PCS footprint roughly covering the same area as the licenses sought in the AWS-1 auction. Fifty of these PCS licenses were sold to Verizon for \$750,000,000 in 2003. Acquisition of the AWS licenses would have recreated a strong regional base in an area where Northcoast had dominated as a PCS provider and from which to acquire national AWS footprint in future

auctions. Five incumbents challenged for the BEA B Block licenses, seven for the C Block licences, and four for the CMA A Block licenses. One incumbent challenged for the REAG D Block license. SpectrumCo LLC acquired the six BEA B Block Licenses. Cingular AWS LLC acquired six of the BEA C Block licenses, SpectrumCo LLC three, Crick Licensee (Reauction) Inc. two, T-Mobile License LLC one, and non-incumbents Vermont Telephone Company Inc., American Cellular Corporation, and Daredevil Communications LLC one each. Cingular AWS LLC acquired the REAG D Block license. A number of incumbents did not persevere on these licenses beyond the withdrawal of Antares Holdings LLC and other non-incumbents which were not seeking the same footprint went largely unchallenged. The appearance of a concerted effort by incumbents to block Antares Holdings LLC is difficult to avoid.

Atlantic Wireless LP sought 34 BEA B Block licenses, forty-eight C Block licenses, thirty-nine CMA A Block licenses, one REG E Block license and one REAG F Block license, covering forty-three states, the District of Columbia, and the northeast region with a covered population of 375,251,473. Atlantic Wireless L.P. is primarily owned by Charles C. Townsend, founder of Aloha Partners L.P. which dominated two earlier lower 700 MHz band auctions with seventy-seven 700 MHz licenses (auction 44) and eighty-nine 700 MHz licenses (auction 49), owning 12MHz of spectrum covering sixty percent of the United States -- including all of the top 10 markets -- and eighty-four percent of the population in the top 40 markets. Atlantic

Wireless was a major contender for establishing a national AWS footprint. Seven incumbents challenged for the BEA B and C Block licenses, eight for the CMA A Block licenses, one for the REAG E Block license, and seven for the REAG F Block license. Atlantic Wireless LP obtained two BEA B Block licenses. SpectrumCo LLC obtained twenty-four BEA B Block licenses, Barat Wireless LP, Cellco Partnership d/b/a Verizon Wireless, Cingular AWS LLC, Cricket Licensee (Reaution) Inc., and non-incumbents American Cellular Corporation and Cavalier Wireless LLC one each. Atlantic Wireless secured twelve BEA C Block licenses. Cingular AWS LLC obtained 13 BEA C Block licenses, Cricket Licensee (Reaution) Inc. nine, T-Mobile License LLC five, SpectrumCO LLC three, MetroPCS AWS LLC two, and non-incumbents Cavalier Wireless LLC, Cincinnati Bell Wireless LLC, Daredevil Communications LLC, and Lynch AWS Corporation one each. Atlantic Wireless LP won one CMA A Block license. T-Mobile License LLC secured seventeen CMA A Block Licenses, Cricket Licensee (Reaution) Inc. eight, Cingular AWS LLC five, Barat Wireless LP one, and non-incumbents AWS Wireless Inc. six and Cincinnati Bell Wireless LLC one. T-Mobile License LLC and Cellco Partnership d/b/a Verizon Wireless obtained the REAG E and F Block licenses respectively. The swarm of incumbents to challenge Atlantic Wireless LP for all but the REAG E Block license, the failure of many incumbents to persevere when Atlantic Wireless LP ceased bidding on a license, and the acquisition of portions of this spectrum by non-incumbents

who did not present a threatening profile argue strongly for incumbent behavior being an attempt to block acquisition of a national AWS footprint by Atlantic Wireless LP. Atlantic Wireless LP did manage to salvage a more restricted position in the face of this onslaught than did Wireless DBS LLC, despite Wireless DBS LLC's better capitalization; this is likely a consequence of Atlantic Wireless LP's more aggressive bidding strategy and willingness to engage in retaliatory bidding.

Dolan Family Holdings LLC aimed at creating a regional base in the northeast with a combination of eight CMA A Block licenses and one each of the BEA B and C Block and the REAG D, E, and F Block licenses, covering six states and the northeast region with a coverage population of 221,258,219. The licenses sought by Dolan Family Holdings LLC represented a strategy of acquiring dominance in the most potentially lucrative region to create a base from which to seek a future national footprint, since the principal stakeholders in Dolan Family Holdings LLC also control Cablevision, the dominant cable provider in New York City. At every turn it was faced by a swarm of concentrated challenges by incumbents: total of four incumbents for the one BEA B Block license, five for the one BEA C Block license, six for the CMA A Block licenses, five for the REAG D and E Block licenses, and two for the REAG F Block license. SpectrumCo LLC took the BEA B Block license, MetroPCS AWS the BEA C Block license. T-Mobile License LLC took four of the CMA A Block licenses and Cingular AWS LLC

one, while non-incumbents American Cellular Corporation took two and AWS Wireless Inc. took one, respectively. MetroPCS AWS LLC took the REAG D Block license, T-Mobile License LLC took the E Block, and Verizon Wireless the F Block. The majority of incumbents did not persevere on these licenses beyond the withdrawal of Dolan Family Holdings LLC and other non-incumbents which were not seeking the same footprint went largely unchallenged. It is difficult to see how these patterns are explainable as anything but a successful, systematic attempt to block Dolan Family Holdings LLC.

NTELOS Inc. is a classic example of a bidder with the bad luck to be in the wrong place at the wrong time. NTELOS Inc. aimed at constructing a Virginia-based network with overlap into neighboring states: three BEA C Block licenses and fifteen CMA A Block licenses, covering Virginia and parts of four other states with a coverage population of 9,184,528. NTELOS Inc. was challenged by three incumbents for two of the BEA C Block licenses and by three incumbents for four of the CMA C Block licenses. Cingular AWS LLC and Cricket Licensee (Reauction) Inc. each obtained one BEA C Block license, as did non-incumbent AWS Wireless Inc. Cingular AWS LLC obtained two CMA A Block licenses and Cricket Licensee (Reauction) Inc. one, while non-incumbents American Cellular Corporation and AWS Wireless Inc. took four and one, respectively. NTELOS Inc. successfully obtained seven CMA A Block licenses. The challenging incumbents persevered to

victory and NTELOS was faced by several better capitalized non-incumbents. It was simply NTELOS Inc.'s misfortune that its bidding profile intersected those of several incumbents. There is no evidence of a systematic blocking pattern in this case.

Wireless DBS LLC presented the most complete attempt of any new entrant to establish a national AWS footprint, bidding on a BEA B Block license, a BEA C Block license, five CMA A Block licenses, and eight licenses in each of the REAG D, E, and F Blocks, covering ten states and eight regions with a coverage population of 974,451,444. An alliance of the two principal providers of DBS television, Wireless DBS LLC sought to gain the terrestrial assets necessary for a national AWS system. This attempt met with the strongest and most concentrated blocking attempt by the incumbents, as a round-by-round case study describes below. SpectrumCo LLC obtained the BEA B Block license and MetroPCS AWS LLC the C Block license. T-Mobile License LLC obtained three CMA A Block licenses and Cricket Licensee (Reauction) Inc. two. T-Mobile License LLC and MetroPCS AWS LLC obtained two REAG D Block licenses each, Cingular AWS LLC, Denali Spectrum Holdings LLC, SpectrumCo LLC, and non-incumbent Spotlight Media Corp. each one. T-Mobile License LLC won four REAG E Block licenses, Barat Wireless LP, Cingular AWS LLC, Cricket Licensee (Reauction) Inc., and non-incumbent American Cellular Corporation one each. Cellco Partnership d/b/a Verizon Wireless acquired four REAG F Block

licenses, T-Mobile License LLC three, and non-incumbent MTA Communications Inc. one. The pattern of incumbent challenges, failure of many incumbents to persevere after Wireless DBS LLC ceased bidding, and the success of less well-capitalized non-incumbents who did not possess Wireless DBS LLC's threatening national footprint profile all militate for this case being a successful blocking action against a targeted new entrant. Wireless DBS LLC was routed by concerted incumbent action.

The effects of this exclusionary strategy were striking, as Table 5 discloses:

Table 5.
Comparison of Incumbents to Targeted Non-Incumbents in the AWS-1 Auction

Incumbents	Total No. of Licenses Bid On	% of Licenses Bid On PWB	Round of Last Bid	Upfront Payment (in \$million)
Barat Wireless, L.P.	66	25.76%	128	80.00
Cellco Partnership d/b/a Verizon Wireless	21	61.90%	135	383.34
Cingular AWS, LLC	209	22.97%	114	500.00
Cricket Licensee (Reauction), Inc.	263	37.64%	115	255.00
Denali Spectrum License LLC	17	5.88%	109	50.00
MetroPCS AWS, LLC	66	12.12%	108	200.00
SpectrumCo LLC	225	60.89%	121	637.71
T-Mobile License LLC	289	41.52%	149	583.52
Mean	144.50	33.59%	122.38	336.20
Targeted Non-Incumbents				
Antares Holdings, LLC	28	0.00%	30	21.00
Atlantic Wireless, L.P.	123	12.20%	97	52.00
Dolan Family Holdings, LLC	13	0.00%	20	149.98
NTELOS Inc.	18	38.89%	104	2.66
Wireless DBS LLC	32	0.00%	11	972.55
Mean	42.8	10.22%	52.40	239.64

Incumbents who targeted new entrants did more than three times better on average at acquiring sought licenses than the targeted new entrants and they were able to persist in the auction on average more than twice as long than the targeted new entrants. Three of the new entrants -- Antares Holdings LLC, Dolan Family Holdings LLC, and Wireless DBS LLC -- were excluded entirely from acquiring spectrum.

The case of Wireless DBS LLC is particularly telling because it implies that initial capitalization of any particular new entrant can be defeated by a “piling on” effect. Even an initial capitalization of \$972,550,00. can be swamped when firms whose combined initial capitalization totals \$2,256,230,000. systematically challenge every bid. It is hardly surprising that Wireless DBS LLC withdrew after the eleventh round.

This strategy adopted by major incumbents in the AWS-1 auction confirms Simon Wilkie’s contention that

[S]tandard FCC spectrum auctions, such as the recent AWS auction, strongly favor local geographic incumbent bidders and disfavor bidders with a national footprint business plan and actively discourage out-of-region competition. This likely means that new entrants, who will need such strategies in order to effectively compete with incumbent wireless providers, are disadvantaged by the auction design.¹⁶

H. Exactly How the Major Incumbents Excluded Wireless DBS: A Case Study

¹⁶ Simon Wilkie, "Spectrum Auctions Are Not a Panacea: Theory and Evidence of Anti-Competitive and Rent-Seeking Behavior in FCC Rulemakings and Auction Design," WT Docket No. 07-16, April 26, 2007, 42.

Table 6 shows the strategic plan of Wireless DBS LLC for acquiring a national AWS footprint and exactly how it was blocked by major incumbents:

Table 6.
Wireless DBS LLC's National AWS Footprint and How Incumbents Blocked It

License	Market Name	Round of First Bid	Round of Last Bid	No. of Bids	Challenging Incumbents (Round of Entry)	Ultimate Winner of License (Round PWB)
AW-REA001-F	Northeast	1	9	9	Cingular AWS LLC (1), MetroPCS AWS, LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (1), Cricket Licensee (Reauction) Inc. (4), Cellco Partnership d/b/a Verizon Wireless (9)	Cellco Partnership d/b/a Verizon Wireless (16)
AW-REA002-F	Southeast	1	10	10	Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (1), Cricket Licensee (Reauction) Inc. (4)	Cellco Partnership d/b/a Verizon Wireless (14)
AW-REA003-F	Great Lakes	1	11	9	Barat Wireless LP (1), Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS LLC (1), Cricket Licensee (Reauction) Inc. (1), SpectrumCo LLC (1), T-Mobile License LLC (1)	Cellco Partnership d/b/a Verizon Wireless (14)
AW-REA004-F	Mississippi Valley	1	11	9	Barat Wireless LP (1), Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (1), Cricket Licensee (Reauction) Inc. (4)	Cellco Partnership d/b/a Verizon Wireless (14)
AW-REA005-F	Central	1	11	10	Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (1), Cricket Licensee (Reauction) Inc. (3)	T-Mobile License LLC (15)

AW-REA006-F	West	1	9	8	Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS LLC (1), Cricket Licensee (Reauction) Inc. (1), MetroPCS AWS LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (1)	T-Mobile License LLC (15)
AW-REA007-F	Alaska	1	2	2	-	MTA Communications, Inc. (119)
AW-REA008-F	Hawaii	1	2	2	Cingular AWS LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (1)	T-Mobile License LLC (108)
AW-REA001-D	Northeast	1	11	7	SpectrumCo LLC (1), Cingular AWS LLC (9), MetroPCS AWS, LLC (9), T-Mobile License LLC (10)	MetroPCS AWS, LLC (18)
AW-REA002-D	Southeast	1	7	5	Cricket Licensee (Reauction) Inc. (1), MetroPCS AWS, LLC (1), SpectrumCo LLC (1)	T-Mobile License LLC (15)
AW-REA003-D	Great Lakes	1	8	6	MetroPCS AWS, LLC (1), SpectrumCo LLC (1), Barat Wireless LP (4), Cricket Licensee (Reauction) Inc. (10)	Denali Spectrum License, LLC (20)
AW-REA004-D	Mississippi Valley	1	8	6	MetroPCS AWS, LLC (1), SpectrumCo LLC (1), Cingular AWS, LLC (4), Barat Wireless LP (8)	T-Mobile License LLC (15)
AW-REA005-D	Central	1	8	6	MetroPCS AWS, LLC (1), SpectrumCo LLC (1), Cingular AWS LLC (10)	Cingular AWS LLC (12)
AW-REA006-D	West	1	8	5	SpectrumCo LLC (1), MetroPCS AWS LLC (6), Cingular AWS, LLC (9)	MetroPCS AWS LLC (14)
AW-REA007-D	Alaska	1	2	2	-	Spotlight Media Corp (147)
AW-REA008-D	Hawaii	1	2	2	SpectrumCo LLC (1)	SpectrumCo LLC (97)
AW-REA001-E	Northeast	1	11	7	T-Mobile License LLC (1), Cingular AWS LLC (9), MetroPCS AWS LLC (9), SpectrumCo LLC (9)	T-Mobile License LLC (17)
AW-REA002-E	Southeast	1	10	6	Cricket Licensee (Reauction) Inc. (1), T-Mobile License LLC (1), Cingular AWS, LLC (9), SpectrumCo LLC (11)	T-Mobile License LLC (19)

AW-REA003-E	Great Lakes	1	10	6	T-Mobile License LLC (1), Cricket Licensee (Reauction) Inc. (3), MetroPCS AWS LLC (6), Barat Wireless LP (8), SpectrumCo LLC (11)	T-Mobile License LLC (19)
AW-REA004-E	Mississippi Valley	1	10	5	T-Mobile License LLC (1), Barat Wireless LP (8), Cricket Licensee (Reauction) Inc. (10)	Barat Wireless, L.P. (16)
AW-REA005-E	Central	1	7	4	T-Mobile License LLC (1), MetroPCS AWS LLC (6), Cingular AWS LLC (10)	Cricket Licensee (Reauction) Inc. (21)
AW-REA006-E	West	1	7	5	Cricket Licensee (Reauction) Inc. (1), T-Mobile License LLC (1), MetroPCS AWS LLC (6), Cingular AWS LLC (9), SpectrumCo LLC (9)	Cingular AWS, LLC (15)
AW-REA007-E	Alaska	1	2	2	-	American Cellular Corporation (152)
AW-REA008-E	Hawaii	1	2	2	T-Mobile License LLC (1), Cingular AWS LLC (8)	T-Mobile License LLC (117)
AW-CMA001-A	New York-Newark, NY-NJ	1	11	5	T-Mobile License LLC (1), Cingular AWS LLC (11)	T-Mobile License LLC (23)
AW-CMA003-A	Chicago, IL	4	4	1	T-Mobile License LLC (1)	T-Mobile License LLC (51)
AW-CMA004-A	Philadelphia, PA	4	4	1	T-Mobile License LLC (1)	Cricket Licensee (Reauction), Inc. (48)
AW-CMA007-A	San Francisco-Oakland, CA	10	10	1	T-Mobile License LLC (1)	T-Mobile License LLC (26)
AW-CMA008-A	Washington, DC-MD-VA	4	4	1	T-Mobile License LLC (1)	Cricket Licensee (Reauction), Inc. (38)
AW-BEA010-B	NYC-Long Is. NY-NJ-CT-PA-MA-VT	5	10	2	Cingular AWS LLC (5), MetroPCS AWS LLC (10), SpectrumCo LLC (11)	SpectrumCo (20)
AW-BEA010-C	NYC-Long Is. NY-NJ-CT-PA-MA-VT	7	10	2	Cingular AWS LLC (3)	MetroPCS AWS, LLC (41)

Wireless DBS LLC's strategy to obtain national AWS footprint initially concentrated on the REAG licenses, particularly the F block. However, immediately a threateningly consistent pattern of challenges from the major incumbents emerged from the first round: in two F blocks (AW-REA003-F – Great Lakes and AW-REA006-F -- West) it received six challenges in the first round, in another (AW-REA004-F –Mississippi Valley) five, in three others (AW-REA001-F -- Northeast, AW-REA002-F -- Southeast, and AW-REA005-F -- Central) four, and in another (AW-REA008-F -- Hawaii) three.¹⁷ On four of these F block licenses additional pile-on challenges by other major incumbents took place in later rounds. These developments led to a decision to suspend bidding on two F block licenses in the ninth round (AW-REA001-F – Northeast and AW-REA006-F -- West) and one F block license in the tenth round (AW-REA002-F -- Southeast).

The strong challenges to acquisition of REAG F block licenses also occasioned two fundamental readjustments of Wireless DBS LLC's strategy, trying to accumulate necessary backup spectrum in the CMA blocks in the northeast, southeast, central, and western regions and BEA C and D block licenses in the northeast in the event that its REAG strategy were to fail.

While Wireless DBS LLC bid on AW-CMA001-A (New York-Newark) from the first round, in the fourth round it bid on AW-CMA003-A (Chicago), AW-

¹⁷ Alaska is anomalous in that Wireless DBS LLC made very little effort to acquire any of the REAG license blocks there. As in Hawaii, which is slightly less anomalous, Wireless DBS LLC made no bids on any Alaskan license after the second round. This probably reflects a decision to suspend bidding until the situation of licenses in the lower forty-eight states was resolved.

CMA004-A (Philadelphia), and AW-CMA008-A (Washington, DC-MD-VA), and was met by strong challenge from T-Mobile License LLC in each. In round ten, Wireless DBS attempted to break out of the stranglehold to its acquisition of an F block license in the west by bidding on AW-CMA007-A (San Francisco-Oakland); again it was met by T-Mobile. The attempts on AW-BEA010-B (NYC-Long Is. NY-NJ-CT-PA-MA-VT) in the fifth round and AW-BEA010-C (NYC-Long Is. NY-NJ-CT-PA-MA-VT) in the seventh round were equally abortive, resulting in withdrawal after the tenth round from both in the face of opposition from Cingular AWS LLC, MetroPCS AWS, LLC, SpectrumCo LLC and Cingular AWS LLC alone, respectively.

In the REAG D and E blocks different, but equally threatening patterns quickly emerged:

- Confrontation by one or more major incumbents in the first round, followed by pile-on of several additional major incumbents from the fourth to eleventh rounds (AW-REA001-D, AW-REA003-D, AW-REA004-D, AW-REA005-D, AW-REA006-D, AW-REA001-E, AW-REA002-E, AW-REA003-E, AW-REA004-E, AW-REA005-E, and AW-REA006-E, and AW-REA008-E). At no point in bidding on these licenses did Wireless DBS LLC face less than three incumbents, except Hawaii, where it faced two.

- On AW-REA001-D (Northeast) and AW-REA002-D (Southeast) Wireless DBS LLC faced the REAG F block pattern: multiple initial challenges from major incumbents.

By the seventh to tenth rounds it was apparent that Wireless DBS LLC was effectively blocked from acquiring the REAG D and E block licenses necessary for a national footprint. By the eleventh round this was equally apparent for the REAG F block licenses. Wireless DBS LLC perforce withdrew from the auction after the eleventh round.

There are a set of tantalizing patterns of incumbent behavior in the REAG D and E blocks which suggests that more than tacit collusion may have been involved. SpectrumCo bid entered in the first round against Wireless DBS 56.33% of the time when it entered. T-Mobile License entered in the first round 75.00% of the time when it entered. MetroPCS AWS LLC entered in the sixth or ninth rounds 66.67% of the time when it entered. Barat Wireless LP entered in the eighth round 75.00% of the time when it entered. Cingular AWS LLC entered in the ninth or tenth round 75.00% of the time when it entered. These patterns are not maintained in the bidding of these incumbents on licenses on which Wireless DBS LLC did not bid and it is difficult to see a strategic reason for this pattern to hold in the REAG D, E, and F blocks on which Wireless DBS LLC bid except as a blocking hierarchy: SpectrumCo LLC and T-Mobile were the early round blockers, MetroPCS AWS LLC and Barat Wireless LP were the mid-to-late round reinforcements, and Cingular AWS LLC was the late round reinforcement. It is difficult to see how this pattern emerged by chance.

The incumbents were remarkably blithe about which incumbent ultimately acquired the licenses, including Verizon, which was the least significant blocker of Wireless DBS LLC. The ultimate allocation generally continued the pattern of incumbents securing spectrum in geographic regions in which they were already hegemonic and avoiding competition within those regional hegemonies. Furthermore, a strong pattern emerged in which the majority of incumbents ceased to pursue the licenses they were challenging once it became apparent that Wireless DBS LLC had dropped out. Table 7 displays these findings:

Table 7.
Patterns of Bidding by Incumbents Prior to and Post Wireless DBS LLC
Withdrawal from Bidding on REAG F Block Spectrum

		AW-REA001-F	AW-REA002-F	AW-REA003-F	AW-REA004-F	AW-REA005-F	AW-REA006-F	Percent of Licenses Bid On
Round of PWB		16	14	14	14	15	15	-
Barat Wireless LP	Prior	0	0	6	7	0	0	33%
	Post	0	0	0	0	0	0	0%
Cellco Partnership d/b/a Verizon Wireless	Prior	1	6	8	6	10	8	100%

	Post	4	3	3	2	2	2	100%
Cingular AWS LLC	Prior	7	6	9	2	8	7	100%
	Post	0	0	2	0	0	0	17%
Cricket Licensee (Reauction) Inc.	Prior	7	7	7	4	6	6	100%
	Post	0	1	3	0	1	0	50%
Denali Spectrum License LLC	Prior	5	1	0	0	0	2	50%
	Post	0	0	0	0	0	0	0%
MetroPCS AWS LLC	Prior	7	0	0	0	0	5	33%
	Post	0	0	0	0	0	0	0%
SpectrumCo LLC	Prior	9	9	9	7	7	8	100%
	Post	0	0	1	0	0	0	17%
T- Mobile License LLC	Prior	7	8	7	7	7	6	100%
	Post	3	3	3	2	3	3	100%

Only Verizon and T-Mobile routinely persevered to the end. The remainder routinely ceased bidding on these crucial licenses immediately after Wireless DBS LLC had withdrawn. This suggests that the bidding prior to Wireless DBS' withdrawal was less "competition" for these licenses than strategic blocking to prevent Wireless DBS LLC from acquiring them.

I. Conclusions and Recommendations for the 700 MHz Auction Rules.

11. It is patent from this study of the AWS-1 auction that signaling remains a problem for FCC spectrum auctions and continues to exhibit potentially large indirect demand reduction effects on auction revenue. As Brusco and Lopomo note in regard to open, ascending auctions generally, these findings also have implications for the efficiency of the final allocation of an auction.¹⁸ Furthermore, a tacitly collusive strategy among major incumbents involving repeated, quasi-simultaneous blocking bids against potentially threatening new entrants to prevent them from acquiring a national spectrum footprint in the AWS-1 auction was identified and appears to have been highly successful. Both signaling and blocking bidding require the ability to identify other bidders round-by-round in the auction. This makes the adoption of anonymous bidding rules all the more imperative.

12. The "compromise rules" on anonymous bidding in the AWS-1 auction were easily evaded. It is likely not accidental that the AWS-1 auction had a surprisingly large number of qualified bidders who never chose to bid in the

¹⁸ *Op. cit.*, 26.

auction and a larger than usual number of bidders who bid on only one license for three rounds or less without acquiring a license PWB. The principal effect of the presence of such bidders was to evade the threshold at which anonymous bidding would have obtained in the auction. It is difficult to imagine what such bidders were doing in the auction except ensuring that the threshold ratio was achieved. Auction rules should not be so easily gamed.

13. The demand reduction effects of signaling observed in the AWS-1 auction (and the earlier PCS D, E, and F auction) should deeply concern the FCC and militate strongly for adoption of anonymous bidding rules for the 700 MHz auction. There is excellent theoretical reason to believe that anonymous bidding will, in fact, be revenue maximizing. In a 2005 study Yossi Feinberg and Moshe Tennenholtz found that in a single-object ascending English auction auction structures in which the identities of bidders are kept anonymous during bidding and (1) participants observe the identity of a bidder which dropped from the auction or (2) participants observe only that a bidder has dropped maximizes revenue to the seller.¹⁹ Since the demand reduction effects of signaling are greater in multi-object , ascending auctions, this result suggests that anonymous bidding will be even more effective in such structures.

14. There is no clear way in which to prevent incumbents from targeting potentially threatening new entrants for blocking bidding other than anonymous

¹⁹ Yossi Feinberg and Moshe Tennenholtz, "Anonymous Bidding and Revenue Maximization," *Topics in Theoretical Economics*, 5:1 (2005), Article 2. Feinberg and Tennenholtz found that neither dropped-bidder mechanism dominated the other in terms of revenue maximization.

bidding: if they cannot identify them, they cannot tacitly collude to block them from obtaining national footprint. Since the rationale for spectrum auctions is the creation of greater competition, it is difficult to see why auction rules should facilitate the ability of incumbents to exclude new competitors.

Appendix: Bidding Profiles of Targeted New Entrants

Table A-1.
Bidding Profile of Antares Holdings LLC

	BEA		CMA	REAG			
	B Block	C Block	A Block	D Block	E Block	F Block	Total
No. of Licenses Sought	6	15	6	1	0	0	28
States/Areas Covered	DC, DE, MA, MD, NH, NJ, NY, PA, RI, VA, VT, WV	CT, DC, DE, FL, IA, IL, IN, MA, MD, MN, MO, NH, NJ, NY, PA, RI, TX, VA, VT, WI, WV	CT, MA, NH, NJ, NY, RI	PR, USVI	-	-	-
Population of Coverage Area	27,347,178	90,548,766	8,244,935	3,917,222	0	0	130,058,101
Challenging Incumbents (No. of Licenses Challenged)	Cingular AWS LLC (3), Cricket License (Reauction) Inc. (4), MetroPCS AWS LLC (3), SpectrumCo LLC (6), T-Mobile License LLC (3)	Barat Wireless LP (1), Cingular AWS LLC (14), Cricket License (Reauction) Inc. (11), Denali Spectrum License LLC (2), MetroPCS AWS LLC (7), SpectrumCo LLC (13), T-Mobile License LLC (7)	Cricket License (Reauction) Inc. (2), MetroPCS AWS LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (6)	Cingular AWS LLC (1)	-	-	-
States/Areas Covered by Challenged Licenses	DC, DE, MA, MD, NH, NJ, NY, PA, RI, VA, VT WV	CT, DC, DE, FL, IA, IL, IN, MA, MD, MN, MO, NH, NJ, NY, PA, RI, TX, VA, VT, WI, WV	CT, MA, NH, NJ, NY, RI	PR, USVI	-	-	-
Population of Coverage Area of Challenged Licenses	27,347,178	90,548,766	8,244,935	3,917,222	-	-	130,058,101

**Table A-2.
Bidding Profile of Atlantic Wireless LP**

	BEA		CMA	REAG			
	B Block	C Block	A Block	D Block	E Block	F Block	Total
No. of Licenses Sought	34	48	39	0	1	1	123
States/Areas Covered	AZ, CA, CO, DE, FL, HI, ID, IL, IN, KS, KY, MA, MD, ME, MI, MO, NC, NE, NH, NM, NV, NY, OH, OR, PA, RI, SC, TX, UT, VA, VT, WA, WI, WV	AL, AR, AZ, CA, CO, DC, DE, FL, GA, HI, IA, ID, IL, IN, KS, KY, MA, MD, MI, MN, MO, MS, NC, NE, NH, NJ, NV, OH, OK, OR, PA, RI, SC, TN, TX, UT, VA, VT, WA, WI, WV	AR, CA, CO, CT, FL, GA, HI, IL, IN, KS, KY, MA, MD, MI, MN, MO, MS, NC, NH, NJ, NV, OH, OR, PA, RI, TN, TX, UT, VA, WA, WI	-	HI	Northeast	-
Population of Coverage Area	72,544,094	161,946,246	89,491,506	-	1,211,537	50,058,090	375,251,473
Challenging Incumbents (No. of Licenses Challenged)	Barat Wireless LP (6), Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS LLC (18), Cricket Licensee (Reauction) Inc. (20), MetroPCS AWS LLC (4), SpectrumCo LLC (32), T-Mobile License LLC (5)	Barat Wireless LP (6), Cingular AWS LLC (35), Cricket Licensee (Reauction) Inc. (24), Denali Spectrum Holdings LLC (2), MetroPCS AWS LLC (10), SpectrumCo LLC (48), T-Mobile License LLC (20)	Barat Wireless LP (6), Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS LLC (25), Cricket Licensee (Reauction) Inc. (29), Denali Spectrum Holdings LLC (2), MetroPCS AWS LLC (7), SpectrumCo LLC (9), T-Mobile	-	T-Mobile License LLC (1)	Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS LLC (1), Cricket Licensee (Reauction) Inc. (1), Denali Spectrum Holdings LLC (1), MetroPCS AWS LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (1)	-

			License LLC (39)				
States/Areas Covered by Challenged Licenses	AZ, CA, CO, DE, FL, HI, ID, IL, IN, KS, KY, MA, MD, ME, MI, MO, NC, NE, NH, NM, NV, NY, OH, OR, PA, RI, SC, TX, UT, VA, VT, WA, WI, WV	AL, AR, AZ, CA, CO, DC, DE, FL, GA, HI, IA, ID, IL, IN, KS, KY, MA, MD, MI, MN, MO, MS, NC, NE, NH, NJ, NV, OH, OK, OR, PA, RI, SC, TN, TX, UT, VA, VT, WA, WI, WV	AR, CA, CO, CT, FL, GA, HI, IL, IN, KS, KY, MA, MD, MI, MN, MO, MS, NC, NH, NJ, NV, OH, OR, PA, RI, TN, TX, UT, VA, WA, WI	-	HI	Northeast	-
Population of Coverage Area of Challenged Licenses	72,544,094	161,946,246	89,491,506	-	1,211,537	50,058,090	375,251,473

**Table A-3.
Bidding Profile of Dolan Family Holdings LLC**

	BEA		CMA	REAG			
	B Block	C Block	A Block	D Block	E Block	F Block	Total
No. of Licenses Sought	1	1	8	1	1	1	13
States/Areas Covered	CT, NJ, NY, MA, PA, VT	CT, NJ, NY, MA, PA, VT	CT, NJ, NY	Northeast	Northeast	Northeast	-
Population of Coverage Area	25,712,577	25,712,577	19,658,795	50,058,090	50,058,090	50,058,090	221,258,219

Challenging Incumbents (No. of Licenses Challenged)	Cingular AWS LLC (1), Cricket Licensee (Reauction) Inc. (1), Denali Spectrum License LLC (1), SpectrumCo LLC (1)	Cingular AWS LLC (1), Cricket Licensee (Reauction) Inc. (1), Denali Spectrum License LLC (1), MetroPCS AWS LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (1)	Cingular AWS LLC (4), Cricket Licensee (Reauction) Inc. (2), Denali Spectrum License LLC (1), MetroPCS AWS LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (8)	Cingular AWS LLC (1), Denali Spectrum License LLC (1), MetroPCS AWS LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (1)	Cingular AWS LLC (1), Denali Spectrum License LLC (1), MetroPCS AWS LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (1)	Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS LLC (1)	-
States/Areas Covered by Challenged Licenses	CT, NJ, NY, MA, PA, VT	CT, NJ, NY, MA, PA, VT	CT, NJ, NY	Northeast	Northeast	Northeast	-
Population of Coverage Area of Challenged Licenses	25,712,577	25,712,577	19,658,795	50,058,090	50,058,090	50,058,090	221,258,219

**Table A-4.
Bidding Profile of NTELOS Inc.**

	BEA		CMA	REAG			
	B Block	C Block	A Block	D Block	E Block	F Block	Total
No. of Licenses Sought	0	3	15	0	0	0	18
States/Areas Covered	-	KY, NC, OH, VA, WV	KY, NC, OH, VA, WV	-	-	-	-
Population of Coverage Area	-	4,368,260	4,816,268	-	-	-	9,184,528
Challenging Incumbents (No. of Licenses Challenged)	-	Cingular AWS LLC (2), Cricket Licensee (Reauction) Inc. (1), SpectrumCo LLC (2)	Cingular AWS LLC (4), Cricket Licensee (Reauction) Inc. (3), T-Mobile License LLC (3)	-	-	-	-
States/Areas Covered by Challenged Licenses	-	NC, VA	NC, VA	-	-	-	-

Population of Coverage Area of Challenged Licenses	-	3,168,887	2,637,570	-	-	-	5,806,457
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**Table A-5.
Bidding Profile of Wireless DBS LLC**

	BEA		CMA	REAG			
	B Block	C Block	A Block	D Block	E Block	F Block	Total
No. of Licenses Sought	1	1	5	8	8	8	32
States/Areas Covered	CA, CT, MA, NJ, NY, PA, VT	CT, MA, NJ, NY, PA, VT	CA, DC, IL, MD, NY, NJ, PA, VA	Northeast, Southeast, Great Lakes, Mississippi Valley, Central, West, Alaska, Hawaii	Northeast, Southeast, Great Lakes, Mississippi Valley, Central, West, Alaska, Hawaii	Northeast, Southeast, Great Lakes, Mississippi Valley, Central, West, Alaska, Hawaii	-
Population of Coverage Area	34,824,383	25,712,577	69,648,766	281,421,906	281,421,906	281,421,906	974,451,444

Challenging Incumbents (No. of Licenses Challenged)	Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS LLC (1), Cricket Licensee (Reauction) Inc. (1), Denali Spectrum Holdings LLC (1), MetroPCS AWS LLC (1), SpectrumCo LLC (1)	Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS LLC (1), Cricket Licensee (Reauction) Inc. (1), MetroPCS AWS LLC (1), SpectrumCo LLC (1)	Cingular AWS LLC (5), Cricket licensee (Reauction) Inc. (5), Denali Spectrum Holdings LLC (2), MetroPCS AWS LLC (3), SpectrumCo LLC (5), T-Mobile License LLC (5)	Barat Wireless LP (2), Cingular AWS LLC (6), Cricket Licensee (Reauction) Inc. (3), Denali Spectrum Holdings LLC (2), MetroPCS AWS LLC (6), SpectrumCo LLC (7), T-Mobile License LLC (6)	Barat Wireless LP (2), Cingular AWS LLC (6), Cricket Licensee (Reauction) Inc. (5), Denali Spectrum Holdings LLC (3), MetroPCS AWS LLC (5), SpectrumCo LLC (7), T-Mobile License LLC (8)	Barat Wireless LP (2), Cingular AWS LLC (7), Cricket Licensee (Reauction) Inc. (6), Denali Spectrum Holdings LLC (3), MetroPCS AWS LLC (2), SpectrumCo LLC (7), T-Mobile License LLC (7)	-
States/Areas Covered by Challenged Licenses	CA, CT, MA, NJ, NY, PA, VT	CT, MA, NJ, NY, PA, VT	CA, DC, IL, MD, NY, NJ, PA, VA	Northeast, Southeast, Great Lakes, Mississippi Valley, Central, West, Alaska, Hawaii	Northeast, Southeast, Great Lakes, Mississippi Valley, Central, West, Alaska, Hawaii	Northeast, Southeast, Great Lakes, Mississippi Valley, Central, West, Alaska, Hawaii	-
Population of Coverage Area of Challenged Licenses	34,824,383	25,712,577	69,648,766	281,421,906	281,421,906	281,421,906	974,451,444

CERTIFICATION

I, Dr. Gregory Rose, hereby declare under penalty of perjury that to the best of my knowledge and belief the above is true and correct.

Gregory Rose
April 17, 2007